Acid rain vs. metal

New Mexico
Supercomputing Challenge
Final report

December 6, 2006

Sponsor: Penevolpe

Team number: 88
Rio rancho high school

Team members:
Natasha Adelmann
Tabatha Chavez

Teacher:
Penevolpe

Project mentor:

Table Of Contents

1. Summary pg. 1

2. Body pg. 3-5

- **a.** Introduction (first paragraph)
- **b.** Description (second paragraph)
- **c.** Results (third, forth & fifth paragraph)
- **d.** Conclusions (sixth paragraph)
- **e.** Recommendations (seventh paragraph)
- **f.** Acknowledgments (eighth paragraph)

3. Appendixes pg. 6

4. Bibliography pg. 13

5. Graphs & Data Tables pg. 14-16

Summary

This project looks at the effects of acid rain on Copper, Iron and Steel in a computer model. The model was done on Starlogo with the turtles as acid rain drops and patches as the metals. Before the program was started, research was done on the rain and metals. This research provided the average ph level of acid rain of 3. Also the strength molecularly of the metals. Off of this information and other facts along with knowledge of starlogo the program was born and experiments were completed.

After the program was created the experiments were done. These experiments produce had mixed results. Therefore an accurate conclusion could not be produced. However steel was the best performer out of all most of the time. So from that steel would be suggested for building materials.

Body

What are the effects of acid rain on the metals copper, iron and steel? This project tries to find the answer to this question using Starlogo. Before the start of the program research was done. *1.*This research produced the average Ph of acid rain of 3. Plus the fact that steel is stronger then copper and copper is stronger then iron. With this knowledge, and the fact that the formulas were not able to be found, an educated guess was made and a number was give to each metal. Iron was given a larger number because it is weaker. Then copper was given a smaller number and steel was given a much smaller number. These numbers give to the metals are the number of patches that the turtles eat before being told to die.

In this project the only materials used were a computer and Starlogo. The first step in creation of the program was research the Ph level of acid rain and rain water plus the strength of the metals copper, iron and steel. *B.* After the research in general the next step is to create the patches that will model the pieces of metal on starlogo, there will be 6 pieces of metal. 2 for iron, 2 for steel, 2 for copper. This was done by typing in the code in the observer and turtle parts of the control center. One of each metal would be smaller than the others but would be the same size as would the larger ones. *A.* Next create the acid rain by typing code in the turtle section of the control center. Then conduct the experiments. After that, analyze the data and create the graphs.

This project has helped the team in understanding acid rain better and its effects on the environment. Plus the fact acid rain mainly only occurs in highly polluted areas due to the fact that acid rain is caused mainly by pollution. *2.*Pollutants stick to water

molecules in the air and in clouds then the clouds move, as the wind carries it away or if the conditions are right it'll start raining. Steel was found to be used the most in building and from the results it was the best against acid rain. Copper is second in buildings and the results. Iron is the last in both areas.

During the creation of the program, several problems were encountered. At first there was no idea how to start the project once the research was done there was the issue with finding the formulas then if they were found how they would be incorporated in the program. However after a lot of research an educated guess was made. With that guess the rates were assigned to the metals each had a different rate. For example iron rusts and breaks down at quicker rate then steel and copper therefore it was given a high rate. Copper was then the middle rate and steel the lowest. The turtles then began to eat to much of the metal. The graph only works when it wants to and the patches don't corrode at the right rates. One being that the turtles (acid rain) would not eat the patch (metals). Then after that problem was solved then the graph stopped working and the turtles stopped moving in a rain like pattern and started moving randomly. Smaller problems would come up every now and again but were taken care of quickly.

The program successfully shows the acid rain eating the metals away. However we could not find the formulas that tell how fast the acid rain, with a certain Ph, should eat through certain metals. Therefore the model was made as accurate as possible with common knowledge and other sources.

In conclusion the program had many problems and after the experiments were done the results were mixed with the smaller amount of acid rain of 50 the steel was the

weakest. However with the higher amount of acid rain of 75 the steel was strongest. So the experiments could not allow a accurate conclusion.

To further the project the next step would be to find the formulas. The results show that steel is the best and iron is the worst at with standing acid rain. Copper was in between steel and iron but it was more like iron. While doing this program the most significant achievement was learning about the effects of acid rain plus learning more about starlogo and programming.

This team would like to thank our families for support. Our teacher Ms. Penevolpe for teaching us about starlogo and how to use it. Also for talking about supercomputing in class and getting us interested.

Appendixes

A. From turtle page in the control center

```
globals [patchsize time]
turtles-own [energy]

to start
move
eat
set time time + 1
if time <= 14600
[
stopall
]
end

to fill
```

```
setxy random screen-width random screen-height
if pc = 3
                [
                fill
                ]
setc 42
setshape shape-12
if pc = 22
                [
                fill
                ]
setc 42
setshape shape-12
if pc = 5
                [
                fill
                ]
setc 42
setshape shape-12
end

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
```

```
; creates turtles on the screen.;

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

to move

wiggle

fd 1

wait 0.05

seth 180

end

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

; this command makes the turtles move and act like rain;

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

to wiggle

rt random 100

lt random 100


end


;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

; turtles eat the shape and die if it eats to much;
```

```
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;


to eat

        if pc = 3

                [

                if numa <= 7

                        [

                        stamp black

                        set energy energy + 1

                        if energy >= 7

                                [

                                die

                                ]

                        ]

                ]


        if pc = 22

                [

                if numa <= 7

                        [

                        stamp black

                        set energy energy + 1

                        if energy >= 14
```

```
                    [
                    die
                    ]
                ]
            ]

        if pc = 5
            [
            if numa <= 7
                [
                stamp black
                set energy energy + 1
                if energy >= 10
                    [
                    die
                    ]
                ]
            ]
        end
```

B. from the observer page in the control center:

patches-own [bkgd1 bkgd2 bkgd3 bkgd4 bkgd5 bkgd6 bkgd7]

breeds [acid]

```
to setup
        ct
        clearplots
        create-acid-and-do numl [setshape shape-12 set energy numa]
        ask-turtles
                [
                fill
                fill
                fill
                ]
end
```

Bibliography

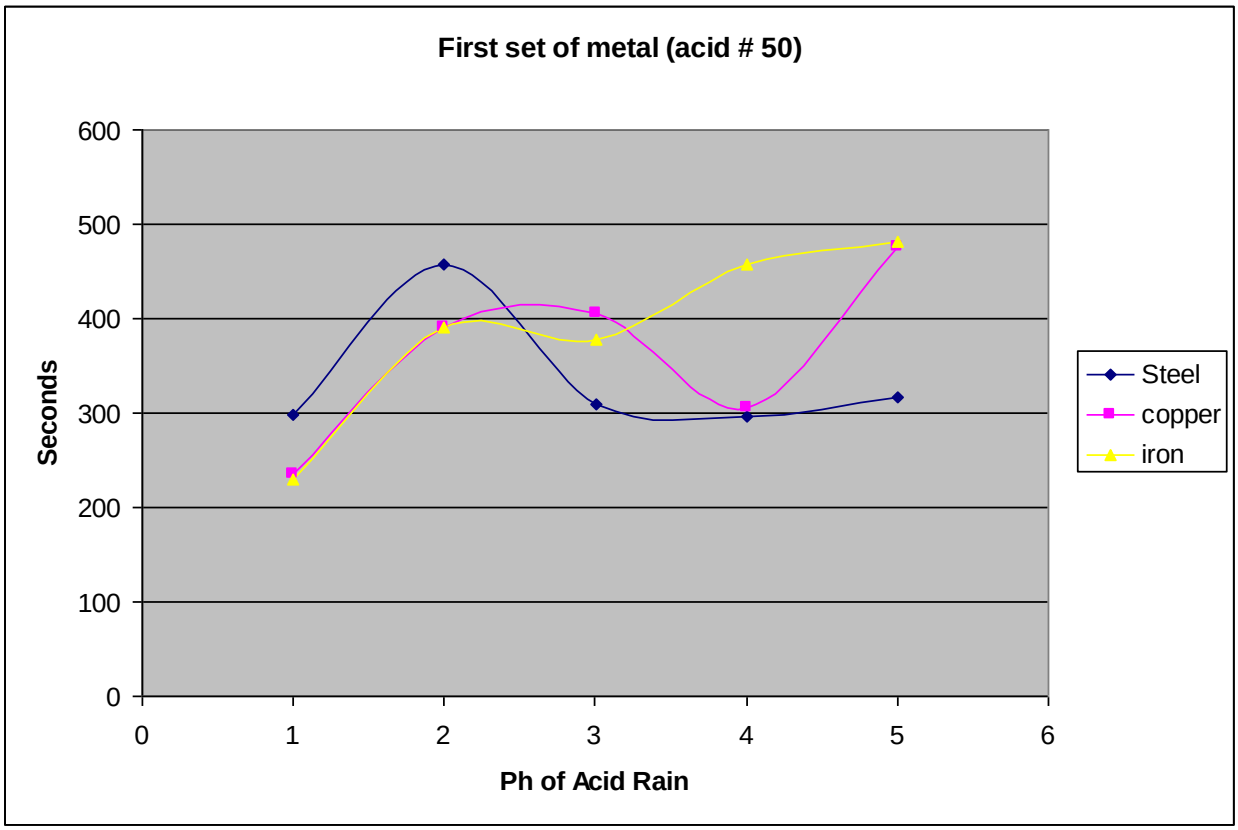
"Acid Rain and .... the Facts." The Green Lane. 29 Mar. 2005. Canada. 14 Sept. 2006 <http://www.ec.gc.ca/acidrain/acidfact.html>.

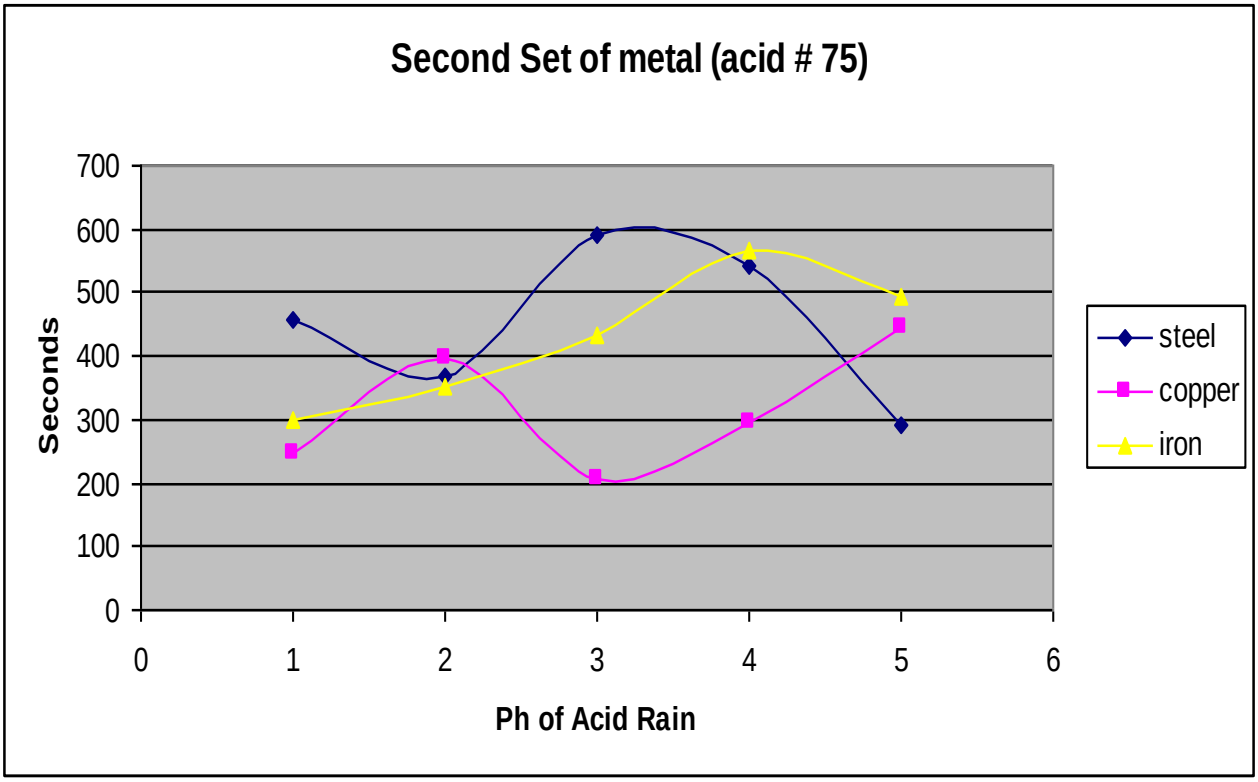
2. "Acid Rain Backgrounder." 1994. 14 Sept. 2006 <http://www.lehigh.edu/~kaf3/books/reporting/acid.html>.

1. Bureau Report. "One Third of China, Victims of Acid Rain." Zee News. 2006. Zee News. 14 Sept. 2006 <http://www.zeenews.com/znnew/articles.asp?aid=318860&ssid=26&sid=ENV>.

Holding, B. V. "Water Treatment & Air Purification." Lenntec. 2005. Lenntec. 14 Sept. 2006 <http://www.lenntech.com/water-pollution-FAQ.htm?gclid=CLeMvO3hpYcCFTY7GAodwQH78A>.

Nesbitt, Weston. "Effect of Acid Rain." Merritton. Merritton. 14 Sept. 2006 <http://www.merritton.ca/effects.htm>.


First set of metal (acid # 50)
600
500
400
300
200
100
0
Seconds
0
1
2
3
4
5
6
Ph of Acid Rain
Steel
copper
iron


Second Set of metal (acid # 75)
700
600
500
400
300
200
100
0
Seconds
0
1
2
3
4
5
6
Ph of Acid Rain
steel
copper
iron

Copper

Number of patches = 196		
ph	**seconds**	**# of acid**
1	235	50
2	390	50
3	405	50
4	306	50
5	476	50

Number of patches = 256		
ph	**seconds**	**# of acid**
1	245	75
2	396	75
3	206	75
4	294	75
5	447	75

Steel

ph	**seconds**	**# of acid**
1	298	50
2	458	50
3	309	50
4	297	50
5	317	50

ph	**seconds**	**# of acid**
1	459	75
2	367	75
3	589	75
4	543	75
5	290	75

Iron

ph	**seconds**	**# of acid**
1	230	50
2	390	50
3	378	50
4	457	50
5	482	50

ph	**seconds**	**# of acid**
1	301	75
2	354	75
3	434	75
4	567	75
5	493	75

Number of patches = 196		
ph	**seconds**	**# of acid**

Number of patches = 256		
ph	**seconds**	**# of acid**

	1	235	50	1	245	75
	2	390	50	2	396	75
Copper	3	405	50	3	206	75
	4	306	50	4	294	75
	5	476	50	5	447	75

	ph	**seconds**	**# of acid**	**ph**	**seconds**	**# of acid**
	1	298	50	1	459	75
	2	458	50	2	367	75
Steel	3	309	50	3	589	75
	4	297	50	4	543	75
	5	317	50	5	290	75

	ph	**seconds**	**# of acid**	**ph**	**seconds**	**# of acid**
	1	230	50	1	301	75
	2	390	50	2	354	75
Iron	3	378	50	3	434	75
	4	457	50	4	567	75
	5	482	50	5	493	75